SCIENCE

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A NATIONAL OBSERVATORY.

THE letters which we publish in this number from prominent American astronomers on the general subject of a national observatory may be regarded as a sequel to Professor Skinner's admirable history of the Naval Observatory found in our issue of January 6th. Justice to the latter institution demands that we should point out certain features of the case which have generally been overlooked. It has been too hastily assumed that the Naval Observatory should fill the requirements of a national astronomical observatory, and that, if it did not, some one must be at fault. To correct this view we have only to cite some authoritative statements on the subject. The matter was stated very forcibly and clearly by Commodore Belknap, Superintendent of the Observatory, as far back as 1885, when the building of the new observatory was about to begin, and when, in consequence, its purposes were the subjects of public discussion. He wrote:

> It is first of all a *naval* institution, its astronomical work being, so far as the *naval service proper* is concerned of a purely secondary consideration. * * * * If the time has come when the purely scientific side of the institution has outgrown the needs of the naval service the converse is true, namely, that the navy

has no need of it or of the scientific staff. If the so-called scientific men of the country think that the time has come to apply to Congress for money to build a national observatory the Navy will not stand in their way; only it will take no responsibility for it, and will be glad to see it go to another department of the government, and to be under purely civilian control, including professors with civilian appointments instead of Naval commissions.*

This official view is enforced by the absence of legislation providing for the organization and government of the institution or prescribing its purposes or functions. Not only has Congress never uttered a word as to its purpose, but it has never, so far as we can learn, provided any authority to determine what work it should undertake. The highest officials recognized in the annual appropriations are assistant astronomers, but there is no statement whom they are to assist. Everything else is left with the Navy Department, which has no way to complete the organization except to order naval officers and professors to duty at the observatory, and establish such rules for their guidance as it may see fit. We are not aware that any regulations have ever been issued prescribing a well-defined plan of astronomical observations. All this accentuates the secondary character of its astronomical work, and justifies the modesty of the part which it has played in the progress of astronomy since the new buildings were erected.

If we accept the preceding view of the functions of the observatory, then we are the only one of the great nations that does not support a national observatory for the promotion of astronomical science. The question is whether our astronomers should not act on the suggestion of Admiral Belknap and petition Congress for the establishment of such an institution as they want. An astrophysical observatory is already supported by Congress under the auspices of the Smithsonian Institution; why should not one for astrometry in its widest range be established under the same or other scientific auspices?

How such a proposal would be met by Congress goes without saying. The first questions would be: Have we not already such an institution? Has not Congress already expended an unprecedented sum in the erection of an observatory? Is it not supported at a greater annual expense than any other similar institution in the world? What has it to do but prosecute the very researches you want prosecuted and make the very observations you want made?

It would be hard to meet these questions without exposing what, at first sight, would seem a weak point. It might not be difficult to convince Congress that an institution where the prosecution of astronomical work was 'of purely secondary consideration,' and which was not specially organized as an institution for astronomical work, could never be expected to fulfil the requirements of a national observatory. But how reconcile the subordination of scientific to naval work with what Congress has actually done? Why should our navy need a great establishment costing nearly a million dollars and fitted up with large and expensive astronomical instruments any more than the English or French or German navy? The English navy has its chronometers rated at the Greenwich Observatory at a very small expense,

*Senate, Ex. Doc., No. 67, 49th Congress, 1st Sess.

and the other countries have small and inexpensive establishments for this purpose. All the national observatories but ours have purely civilian organizations. Why should ours be an exception?

Under these conditions what is wanted is that our astronomers and naval authorities should come together and agree upon a plan. Nothing can be worse than the continuation of a system under which the country goes to all the expense of supporting a great observatory without reaching results commensurable with the expenditure. It is sometimes claimed that naval officers will not give up any part of their control. It seems to us that this claim involves a reflection upon their patriotism and their regard for their country's interests which they should not tolerate. Congress gives its munificent support to the observatory under the belief that it is supporting a great and useful scientific establishment which is extending the fame of our country in the intellectual field as the observatories of Greenwich and Paris have extended the fame of the countries which have supported them. If this belief is ill founded the claim in question amounts to nothing less than saying that our naval officers will fight for the privilege of expending large sums for objects which neither increase the efficiency of the service nor promote the scientific standing of the country in the eyes of the world. We cannot suppose them animated by so low a spirit as this attitude presupposes. We believe that they are sincerely desirous of seeing the great institution established at such expense made a credit to the country, and that if fifty years' experience shows that this end can be reached only by separating the naval from the scientific work of the establishment, and placing the latter under the only sort of control that can ever be really successful, they will, in the words of Commodore Belknap, 'not stand in the way.' It is the duty of our astronomers to use their influence in making the exact facts of the case known, and in promoting such a solution of the problem as will conduce to the good name of American science.

Were we dealing with a small institution to which Congress extended only a niggardly support, we might look with indifference on a corresponding paucity of performance. But when Congress bestows a far more liberal support on our observatory than England, France or any other nation bestows on its national observatory, and does this in the belief that it is promoting astronomical science to a corresponding extent, patriotism demands that our astronomers should inform our authorities whether this belief is or is not in accord with the fact.

DISCUSSION OF A NATIONAL OBSERVATORY.

IN response to a letter sent to a number of leading American astronomers the replies printed below have been received.*

The letter asked for answers to the following questions:

1. Is it desirable that the government of the United States should support a national astronomical observatory?

*** In addition to these replies a committee appointed at the Harvard Conference of Astronomers and Astrophysicists, consisting of Professor E. C. Pickering, Harvard College Observatory (Chairman); Professor George E. Hale, Yerkes Observatory, and Professor George C. Comstock, Washburn Observatory, has drawn up a report on the subject, which we hope to publish after it has been presented to the next Conference.**

2. If so, what ends should such an institution have in view; especially to what classes of astronomical observation and research should it be devoted?

3. Does the new Naval Observatory fulfill the objects in question so completely that no other institution of the kind is necessary? If not, in what respects does its work differ from that required for the purposes in view?

To the Editor of Science: In answer to your questions as to the policy of supporting a national observatory, I would say that, making abstraction of features peculiar to astronomical science I see no reason why the government should support an astronomical observatory any more than a chemical laboratory for chemists to use in making their experiments. The exceptional reason in favor of an observatory is that there are branches of astronomical science of world-wide interest and importance which are not adequately cultivated by private enterprise. The greatest of these relate to the motions of the heavenly bodies, especially the fixed stars. Of late years it has been seen that the study of these motions may throw light on problems formerly regarded as insoluble, and supply posterity with records of priceless value in the advance of knowledge.

An institution to supply the want thus indicated should be organized and fitted up with its own special end in view, and should not be diverted from that end by the temptation of more attractive work in other directions. The later results of experience and research should determine the instruments to be used, and the whole arrangements should be such as to command the best talent and skill in planning and executing the work.

Simon Newcomb.

To the Editor of Science: The astronomical questions you propose to discuss in Science are interesting. Since I hold a position in the Navy it is not proper for me to discuss the conduct of the Naval Observatory. As to the other questions I may say briefly:

1. I think it is desirable that the government of the United States should support an Astronomical Observatory.

2. I think such an observatory should determine the positions of the stars, planets and satellites with the greatest accuracy possible, since theoretical astronomy rests on such observations. The astro-physical departments of astronomy are so attractive that they will not lack investigators.

Asaph Hall.

Harvard University.

To the Editor of Science: Replying to questions raised in your communication of December 4, 1898, I would say:

I. I think that unquestionably the United States ought to support a National Observatory, unless it is willing to fall to the rank of a third-rate nation. Besides, we already have a fine building, with a costly and valuable equipment of apparatus. It would be a disgrace to abandon it.

II. As to the ends to be kept in view, etc., I think a National Observatory, maintained by the government, should aim chiefly at kinds of work not easily within the reach of private and educational observatories—extended series of observations which require persistent prosecution without intermission or material change of plan—such, for instance, as:

(*a*) Continuous observations of the positions of the sun, moon and planets, partly by the meridian circle, and partly, perhaps, by photography, which is specially valuable in the case of such asteroids, as, for one reason or another, require attention. Observations of comets are also in order.

(*b*) The determination of the absolute positions of a reasonably large list of fundamental stars, and of such other stars as are needed for reference points by observers of planets or comets, or by those engaged in geodetic operations.

(*c*) I think it desirable also that certain astrophysical observations should be included, especially in the line of stellar spectroscopy, since the number of objects of investigation in this line is so great that the ground cannot be covered in any reasonable time without the general cooperation of all well-equipped observatories.

(*d*) The refined reduction and prompt publication of the results of observation. This implies a thorough mathematical study of the theories involved and investigation of their corrections, and requires that among the as-

tronomers of the observatory there be included able mathematicians as well as skillful observers. Joined with this work is very properly the calculation and publication of the National Astronomical Ephemeris, or some definite portion of an International Ephemeris, if such a work can be arranged for, as is now proposed in certain quarters.

III. I do not think that the National Observatory, whether organized as the present Naval Observatory or on any other plan, can wisely undertake to deal with all classes of astronomical observation. There are numerous lines of investigation which can better be followed up by institutions organized for the special purpose, or by individual amateurs. Nor do I believe that under its present organization, nor under any organization which leaves it distinctively a naval institution, managed and directed according to naval traditions and methods, can it ever well fulfill the ends of a National Observatory. The pursuit, and especially the superintendence and direction of astronomical investigation, is purely scientific work, and should be under scientific control.

As to the question whether another observatory (for astro-physical investigation I suppose) should be founded and maintained by the government I am hardly clear. The examples of France and Germany, and to a certain extent that of England, point in this direction. But so long as the observatories at Cambridge, Mt. Hamilton and Lake Geneva maintain their astro physical activity it seems to me hardly necessary for us to move in the matter.

PRINCETON, N. J. C. A. YOUNG.

TO THE EDITOR OF SCIENCE: As I am not an astronomer there is no reason why my opinion should appear in your symposium on the National Astronomical Observatory. Your request that I should furnish it originated, doubtless, in the fact that I was appointed, at the Boston meeting of the A. A. A. S., a member of a committee of which Professor E. C. Pickering is Chairman, to consider and report upon the organization and work of the Naval Observatory at Washington, which stands for whatever we have or have not in the way of government astronomical research at the present moment. At any rate I will venture upon a very brief discussion of the questions involved as I see them.

To the first question I would reply that we already have and have had for many years a National Astronomical Observatory in the Naval Observatory at Washington. Congress has already shown its willingness to maintain such an institution in the magnificent buildings and expensive equipment for which it has generously appropriated money and for the support of which it makes liberal annual appropriations. It is too late, therefore, to discuss your first query, but the all-important question is the third: Does the Observatory as organized and managed at present fulfill the requirements of such an institution? On this point there is room for much discussion and, perhaps, some difference of opinion. My own answer would be: No. But there is likely to be a tendency to misrepresent the views and attitude of naval officers in this matter, and, without pretending to speak for them or by their knowledge or consent, I venture the opinion that a large majority of them, especially of those generally acknowledged by their comrades to be the foremost men in the service, would be found in substantial agreement with the leading astronomers of the country. It has been my privilege to enjoy rather intimate association with many of them, and I have always found them unselfishly devoted to the best interests of their corps, always ready to discharge in the most conscientious manner any duty with which they may be charged, doing the very best they can under the conditions and restrictions by which they are surrounded.

That they should have a pride in the development of the great institution which has been for so many years under their care is only natural. Originally the Naval Observatory was just what was required by the navy; but, by its gradual expansion into an establishment fitted for astromical research on an almost unrivalled scale, it has become very much of an elephant on their hands. But to expect that they will voluntarily relinquish all claim to or interest in it is to expect what is unreasonable. I am sure that the great majority of them know that the spirit of a military regime, which is at

once a virtue and a necessity in a military corps, is quite imcompatible with the spirit of scientific investigation pure and simple. So long as the Observatory is under a bureau of the Navy Department it must, of necessity, like a navy-yard or a receiving ship, be controlled by naval regulations, and any relations which naval officers may sustain to it must be governed by navy rules regarding rank, short details of service, assignments in regular order without regard to special fitness or taste and other established customs, absolutely necessary to military discipline, but utterly irreconcilable with the spirit of an institution devoted purely to scientific research. The only satisfactory solution of the problem is the removal of the Observatory from military control. No half-way measure, such as appointing a Director from civil life, will avail as long as it remains attached to the Navy Department. The amputation must be clean and complete.

If any attempt is made to accomplish this it must be kept in mind that it is a fundamental principle of bureau administration to get hold of all you can and hold all you get. It is accepted as an evidence of successful administration to have added one or more new functions to the office which you happen to hold, and it is considered almost disgraceful to allow another bureau to begin operations in a field which you have traditionally cultivated, however unrelated they may be to the work for which your corps was originally organized. Much of the useless duplication of government work is due to this.

It must also be remembered that Congress concerns itself very little with what ought to be done, but that it is very greatly influenced by what it is made to believe the people want done. As far as the interests of astronomy go, astronomers are the people. Whenever they are ready to unite in a persistent effort to secure reform in the Naval Observatory, whenever they are willing to exert their influence in favor of making it a real national establishment, directed by astronomers for astronomy they will succeed. Naturally there will be a few naval officers who will seriously oppose any measure which deprives them of such agreeable shore duty, but the great majority of them know very well that to them professional distinction is to be reached through skill in handling a 10-inch gun rather than a 26-inch objective and that the experience of commanding a battleship is vastly more valuable than anything to be gained in the performance of the petty routine duties of superintending an institution in whose work they have little real interest and no enthusiasm.

T. C. Mendenhall.

Worcester Polytechnic Institute.

To the Editor of Science: I beg to offer the following replies to the questions you raise with reference to a national astronomical observatory.

First, it is desirable that the government of the United States should maintain an astronomical observatory. The experience of the past two hundred years seems to demonstrate that there are certain kinds of scientific work that cannot be successfully carried on without the express sanction and support of stable governments.

Astronomy, geodesy and geology are the most striking instances of such work, and it is hardly conceivable that they could have attained their existing degree of utility except for the aid extended to them by the leading governments. That the maintenence of such work is second only in importance in national economy to the maintenance of law and order, and to the diffusion of education, is a proposition which few readers of Science are likely to controvert.

Secondly, the chief objects of a national astronomical observatory seem to fall under the following heads: (a) the registration of continuous series of observations of the sun, moon, planets and fixed stars; (b) the preparation of ephemerides of these celestial bodies for the use of surveyors, geodesists and navigators; (c) theoretical investigations with reference to the motions and physical properties of the celestial bodies, and with reference to the instruments, appliances and methods used in astronomical observations and computations; (d) the cooperation with other similar organizations in astronomical undertakings of international importance.

Thirdly, it may be said that the existing Naval Observatory has fulfilled and still fulfills

these objects. It must be admitted, in fact, that the Naval Observatory, during the half century of its existence, has done a large amount of first class work, and that its service has been dignified by the connection with it of some of the most eminent American astronomers. Nevertheless, it appears equally just to affirm that the administration of the Naval Observatory has never been favorable to the highest efficiency of such an organization. The scientific work of the Naval Observatory has been done in spite of a bad form of administration rather than by reason of a good one.

The radical defect of this administration lies in the assumption that the Superintendent of the Observatory should be, as he has been, generally, a naval officer, who may have little knowledge of or interest in astronomy. The position is one of pleasing prominence to an officer on shore duty, and is hence likely to fall to one who has 'pull' with the party in power rather than to one who has distinguished himself as an astronomor. The effect of such administration is much the same as would result in a university if the department of mathematics, for example, were placed in charge of a superannuated clergyman. The routine work goes on pleasantly, but with no scientific energy except that which the subordinates get from external professional associations. Subordinates who are exceptionally able may, as some have done, accomplish much good work under such depressing circumstances; but those less ambitious are apt to lapse into mere time servers. This form of administration leads also to pressure for position in the service by those little competent to undertake astronomical work. The way in which some of the highest positions on the Naval Observatory staff have been obtained in recent years, through 'pulls' and 'influence,' and competition of all kinds except that of merit, is a standing disgrace to all men of science.

To remedy these defects, and to make of the Naval Observatory a National Observatory, some rather radical changes are essential. The Observatory should cease to be a mere bureau of or appendage to the navy, and the surest way to accomplish this end will be to transfer the Observatory to some other department. The Director or Superintendent of the Observatory should be an astronomer of acknowledged ability, and the members of his staff should be chosen by reason of merit only. The conduct of the work of the Observatory should be subject to the approval of a board of regents, similar to that of the Smithsonian Institution, half of whom should be chosen from astronomers and physicists not in the government service, and half from members of Congress. Some such system of administration, free so far as practicable from the contamination of spoils and politics, appears to be absolutely indispensable to the maintenance of an Observatory worthy of American science.

R. S. WOODWARD.
COLUMBIA UNIVERSITY.

TO THE EDITOR OF SCIENCE: In reply to your questions relating to the United States Naval Observatory I assume that you do not expect an elaborate article, but merely the expression of my individual opinion in a few words. I take the topics in order.

I. If no such establishment existed, and it were a question of founding an observatory, I should say *no*. At least not before government methods had considerably improved.

With buildings and plant on hand, which have cost nearly a million of dollars, it is probably best to keep it up, though I am not quite sure of this.

II. Systematic work with meridian circle in determination of places of stars and planets. Measurements of double stars and positions of comets and minor planets with the equatorial. In short, the kind of work which Hall and Eastman kept up for many years and which is not likely to receive the necessary attention at private observatories.

III. I do not quite understand this question. If the meaning is as follows: Is it desirable for government to establish another observatory in order to atone for the shortcomings of that now existing? there can be only one answer.

The requisite conditions, in my opinion, are not likely to be fulfilled by any observatory established within the political atmosphere of Washington.

C. L. DOOLITTLE.
FLOWER OBSERVATORY.

To the Editor of Science: In reply to question number one I should say: Had we no observatory, no. It does not require a 26-inch telescope to test a chronometer. (2) Since we already have such an institution, it seems to me that the best work it can undertake will be large and expensive pieces of routine work, such as a private observatory would be unlikely to take up, and could only be accomplished by a combination of them. (3) The Naval Observatory certainly does not fulfill this idea. The work it is to undertake should, I think, be decided by a committee suitably appointed. It should have a civilian astronomer at its head.

W. H. Pickering.

Harvard College Observatory.

To the Editor of Science: The question whether the United States should maintain a National Astronomical Observatory must largely depend for its answer upon the opinion which we may adopt with regard to the propriety of employing money raised by taxation in the support of any branch of pure science. It may be held that the taxpayers should not be made to contribute to undertakings in which they cannot be supposed, as a whole, to feel any decided interest, and which, so far as they are beneficial, must benefit mankind at large, rather than the particular nation supporting them. But various branches of applied science must be cultivated at the national expense, and it is difficult to draw a definite boundary separating abstract inquiries and their practical applications. Some liberty of research, too, on the part of men engaged in any scientific work, seems desirable to prevent them from falling into too mechanical a routine. In this country, where the science of astronomy is so liberally supported by private munificence, there is, doubtless, very little occasion for a National Observatory; still, since such an institution exists, and has done much interesting work, as Professor Skinner shows, most of us would probably dislike to have it abandoned without further trial.

The most obviously valuable service which a National Observatory can render is the maintenance of such observations as are apt to be neglected elsewhere, from their want of immediate interest. Such, for example, are the determinations of position of the sun, moon and planets, which have been kept up assiduously at the Naval Observatory since 1861, as Professor Skinner assures us at the close of his article. It would hardly be advisable to confine the work of the institution rigidly to a routine of this kind, so planned as to leave the astronomers no time for pursuits more stimulating to the intellect; but if they should attempt to undertake all kinds of researches most in vogue at the present moment we could not expect from them many solid additions to human knowledge.

I do not feel myself competent to judge whether the Naval Observatory is to be regarded, comparatively speaking, as a success or as a failure, or whether any change in its organization would decidedly improve it. I know that complaints of the amount and quality of its work have often been made, and I have been puzzled by the manner in which these complaints have been met. In similar cases we usually find the persons criticised inclined to excuse what may seem to be their shortcomings by their want of means, or by the uncertainty whether their present pecuniary support will be continued, or, perhaps, in other instances, by a defective organization imposed upon them from without. But, unless I misunderstand what I have heard, the astronomers of the Naval Observatory generally agree that their chief has all necessary power to carry out his plans promptly and effectively; that this power hardly needs to be exerted, because they form a united and harmonious body, animated by purely scientific zeal; that Congress has supplied them abundantly with funds, and that they entertain no apprehension that this liberal support will be withdrawn, or that they will be under the necessity of neglecting their scientific pursuits in order to solicit its continuance. If this impression of mine, which I acknowledge to be a vague one, is correct, either the critics must be in error or there is something in the mere atmosphere of Washington, or in any connection with the government of the United States, which is unfavorable to the cultivation of astronomy.

Public criticism of a public institution must

not be blamed, even if it is ill founded; and I am inclined to depend upon it for the correction of any defects which may exist in the management of the Naval Observatory. If the critics cannot agree among themselves no change is probably required, but if there is a general accordance among them it will be difficult for the Washington astronomers to persist in opposition to the scientific sentiment of the country. For example, the publication of the Washington observations has often been considered needlessly irregular and dilatory. If this criticism is just, and if the Naval Observatory has ample means for the reduction and publication of its work, I can hardly doubt that the mere repetition of the complaint will before long succeed in removing the occasion for it.

ARTHUR SEARLE.

HARVARD COLLEGE OBSERVATORY.

TO THE EDITOR OF SCIENCE: Your questions are fundamental.

1. The right to existence of a National Astronomical Observatory supported by the United States seems to me beyond dispute, and this too for the reason that certain classes of astronomical observations, such as those of the positions of sun, moon and the larger planets, must be maintained with a regularity seldom attained in an observatory subject to the vicissitudes of a changing policy or to the fluctuation of available funds. In general, those researches which demand long series of observations whose accumulation is likely to outlast the activity of an individual astronomer require an institution having the stability of a National Observatory.

For example, Holden's inquiry as to the evidences of change of form in nebulæ, which appeared in the Washington Observations for 1878, is a preliminary discussion whose final answer can best be given by comparison of a series of photographs taken under identical conditions at regular intervals and accumulated perhaps for some centuries. Such a work seems eminently suitable for a National Observatory.

But (3) the New Naval Observatory does not now fulfill, and need never fulfill, these objects so completely that the cooperation of other institutions shall be unnecessary; and a carefully considered scheme for the division of labor and the cooperation of working astronomers would add to the efficiency of every observatory in the land. Indeed, it may be said that already, without any set compact, there is a tacit recognition of the fitness of individuals for special work, and a partial relinquishment of such work to the men whose attainments, or the institutions whose outfits, promise the best results.

It would be very easy to criticise the present Naval Observatory, but probably few of us could do better under the existing system, which is not sufficiently elastic, and which fails to recognize that Science is like a living plant and must have room to grow. I will confine myself to one example. The accumulation of accurate magnetic records, and their comparison with cosmic phenomena, ought to be an uninterrupted work, undertaken with the design of making it permanent, and as such it is suitable for a National Observatory. The folly of continuing magnetic observations in the rapidly altering environment of a great city, where electric currents generate a variable magnetic field of their own, has been abundantly demonstrated. Scientific opinion and common sense demand the immediate removal of the magnetic part of the working outfit of the Naval Observatory to one or more suitable localities, far removed from civilization, but the sluggish response of a conservative authority which finds it difficult to conceive of a National Observatory in any other place than Washington, D. C., bids fair to leave a gap in our records unless individual action comes to the rescue. Now, while it is not desirable that an institution having the especial character of permanence should shift its policy on small provocation, there ought be freedom to meet emergencies.

FRANK W. VERY.

BROWN UNIVERSITY.

TO THE EDITOR OF SCIENCE: In response to your significant enquiries:

1. *Is it desirable that the government of the United States should support a national astronomical observatory?*

Yes, the United States, as a leading nation of the globe, is virtually pledged to equip and

maintain an astronomical observatory of the first order.

2. *If so, what ends should such an institution have in view, especially to what classes of astronomical observation and research should it be devoted?*

Such classes of observation and research should be conducted as will be of the utmost practical utility:

(*A*) Observations for determining the precise positions of the stars upon the celestial sphere.

(*B*) Spectroscopic observations of precision for determining the motions of fixed stars toward and from the solar system.

One telescope of exceptional size should be devoted to this work.

(*C*) Determination of the distances of the principal fixed stars.

(*D*) Accurate evaluation of the elements concerned in the motion of the earth's pole of rotation.

A zenith telescope of the best construction, preferably photographic, should be constantly employed upon this research. Cooperation with the Coast and Geodetic Survey, and the uninterrupted support of an additional observer in Manila or Honolulu, is highly desirable. This service should be maintained with the utmost rigor for at least twenty-five years.

(*E*) Meridian observations of position of the sun, moon and major planets.

Planetary observations should be converted into errors of celestial longitude and ecliptic north polar distance, and equations formed connecting these errors with the elements of the planetary tables used in the preparation of the Nautical Almanac.

(*F*) Searching investigation of the constant of meridian refraction should be conducted uninterruptedly throughout a series of years.

(*G*) Equatorial observations not previously specified. These need be but few.

(*H*) Solar research in several departments.

1. The spots, their number and area, photographically and visually. An independent record should be maintained in either Manila or Honolulu, thereby supplementing, at half intervals, the similar work at Greenwich, Dehra Dûn and the Mauritius.

2. The prominences, photographically and visually.

3. The faculæ, with the spectroheliograph.

4. The corona, during total eclipses, chiefly photographically.

5. The Sun's Reversing Layer.

6. Bolometric investigation of the infra-red rays of the solar spectrum.

7. The permanency in character or the secular variation of lines in the solar spectrum.

8. The permanency or secular variation of the solar constant. In the prosecution of 6, 7 and 8 a high-level station might advantageously be maintained, in either Hawaii or southern California.

(*I*) The department of the Astronomical Ephemeris and Nautical Almanac should not only prepare and publish this work, at least three years in advance, but should issue also accessory publications of especial service to navigators.

(*J*) Magnetic observations ought to be maintained, as regards declination, dip and intensity.

(*K*) A time-service must be maintained, not only for the purpose of the Navy, but for the wide distribution of standard time and the dropping of time-balls at important localities.

The Superintendent or Director of the government observatory should be held responsible for the efficient prosecution of all branches of the work under his charge and for its prompt publication. Also he should be empowered to choose his subordinates, with or without examination, their recommendation for appointment to be subject to approval by a Board of Visitors at semi-annual sessions. Advancement and discharge should be regulated in a similar manner.

David P. Todd.
Observatory House, Amherst, Mass.

To the Editor of Science: To the three questions submitted to me a few days since by yourself I would reply as follows:

1. It is most emphatically desirable that the government of the United States should support a National Astronomical Observatory. There are certain important lines of astronomical research which are of a character such as not to appeal to the popular interest and which, if left to be taken care of by private endowment,

will not recieve proper attention. To these the institution should be devoted.

2. Such an institution should have in view research work primarily. The training of specialists should not be ignored. The lines of astronomical research which should receive special, if not exclusive, attention by such an institution should lie within the scope of what is recognized by astronomers as astronomy of precision, though I would not exclude from the realm of precise astronomy some lines of astro-physical research.

3. Most emphatically it does not. Routine work, such as the rating and testing of chronometers and operating a time system, etc., should be no part of the work of a National Astronomical Observatory. The organization of the observatory should not be such as to hinder the most efficient service of its officers nor to curb or discourage the ingenuity of subordinates. Individual initiative should be given freest play. The machine system of Sir George B. Airy, more in vogue elsewhere than in the New Naval Observatory however, and so enthusiastically befriended by directors of observatories, should have no place in its organization, or operation. It should not be a *one-man* institution in the sense that most institutions of this sort have been which have been called into existence among us in these latter days and have too frequently been made to play the part of machines to lift their directors into notoriety. In a single word, the organization of the institution should be democratic and not autocratic.

G. W. MYERS.

UNIVERSITY OF ILLINOIS.

TO THE EDITOR OF SCIENCE: I will briefly answer your questions even though I do not feel suitably prepared to offer unanswerable proofs or cite dates, events, etc.

1. I feel that it is imperative that the government of the United States should support a National Astronomical Observatory, not necessarily at Washington.

2. Only through the work of that Observatory the usual tables of coordinates and other data can be efficiently and officially produced to serve the purposes of navigation, etc.

3. The Naval Observatory does not fulfill all the conditions that it should, so as to bring to American science an amount of credit proportional to what is done in other branches of the government. The National Observatory should make investigations of all kinds with reference to astronomy, geodesy, meteorology and also in astro-physics. It should largely extend its list of apparent places and also add to the American Ephemeris a larger list of mean places for the better determination of latitudes throughout the country.

4. I can see no reason why the National Observatory should not engage in every branch of astronomy in which other observatories are at work. The only trouble lies in the administration of the National Observatory. I do not know how things are there at present; but our Observatory used to be a source of pride and usefulness to American scientists; and since it has been placed under the control of line officers it has done very little remarkable work, and several of its best men have gone elsewhere. It seems that military life leads even the best of men to do routine perfunctory work, and when the line officers look down upon the Naval Observatory professors as subordinates or inferior beings there are a large number of considerations which tend to diminish the ambition which is the result of industrious zest in scientific work.

I cannot see why the United States government could not have in this astronomical observatory great men adequately paid, in a perfectly defined high social position, and with sufficient appropriations to be engaged in useful research. The nature of the case demands the existence of several observatories, properly located geographically within our vast domain, which now extends around the earth.

E. A. FUERTES.

CORNELL UNIVERSITY.

TO THE EDITOR OF SCIENCE: In answer to the questions you have laid before me I may say:

1. In my opinion there can be but little doubt as to the desirability of a National Astronomical Observatory, supported by the government of the United States. Our geographical position on a meridian one quarter way or more around the globe from those of the great Euro-

pean national observatories affords the means of supplementing, in a valuable manner, the work carried on by them, while our more southern latitude extends the limit and increases the accuracy of useful observation below the equator.

2. The sphere of work of a National Observatory appears to me to comprise mainly such classes of research as cannot well be undertaken by university observatories. Of these we have quite a number, some with the most powerful of equipments, but in general they are likely, I think, to devote themselves to investigations which promise an immediate return of results. The systematic continuous observation of the bodies of the solar system for position, such as has been prosecuted at Greenwich; the construction of catalogues of fundamental stars, such as those furnished by the Pulkowa observatory; the procuring and measurement of photographic plates of the heavens on the plan inaugurated by the observatory at Paris, seem to me, for instance, fields which require such large resources as scarcely any but a national institution can command.

3. I should consider the present site of the New Naval Observatory an admirable one and the equipment in a considerable degree sufficient for the purposes of a National Observatory There should, doubtless, be added a powerful photographic apparatus.

W. L. Elkin.
Yale University Observatory.

To the Editor of Science: At your request I give my opinion on some questions relating to the establishment of a national observatory in this country, although I believe that it does not differ materially from the opinions of other American astronomers.

It seems to me highly desirable that the United States, like other leading governments, should support a national astronomical observatory. In the U. S. Naval Observatory, the honorable history of which has recently been so well told in these pages by Professor Skinner, the government already possesses suitable buildings and instruments and certain changes in the organization are alone required to convert this institution into a national observatory of the first rank.

The opinion, which is probably widely held among astronomers, that this observatory would be benefited by a change in its organization, is based on general considerations and does not reflect on any individuals or class of men. The splendid efficiency of our naval officers in their own profession is due not merely to natural ability and aptitude, but to a long course of preparatory technical training. Astronomy is likewise a science which demands the whole of a man's best energies. Common sense, therefore, as well as the example of other nations, clearly indicates that a national observatory should be under the charge of an officer who has made astronomy his life work. To place it under the charge of one whose training has been along different lines is as objectionable as would be the appointment of civilians to responsible military commands.

The work of a national observatory would naturally lie mainly in the field of the older astronomy, more particularly in the making and discussion of those fundamental observations of the positions of the heavenly bodies which owe a large part of their value to their continuity, and which, therefore, require permanent, thorough organization and secure financial support. The private or small observatory enjoys the privilege, in some degree compensatory for the many disadvantages under which it generally labors, of taking up researches of doubtful promise without being called to account in case of failure. The elaborately equipped and organized government institution devotes most of its energies to work of which the results are certain, the exploration of new fields and experiments in general having only a secondary place in its program.

Professor Skinner's article shows that only a small part of the work done at the Naval Observatory has any direct reference to the needs of the Navy Department, while by far the greater part is such as would properly come under the province of a national observatory. The requirements of the navy could, I think, easily be met by a national observatory by adopting such methods of coöperation as already exist in other parts of the government service.

James E. Keeler.
Lick Observatory.

THE ATOMIC WEIGHTS—A QUARTER CENTURY'S PROGRESS.

IT may be of interest so near the close of the century to follow a good commercial precedent and make an inventory and strike a balance so as to gain some idea of the progress in chemistry. One portion of our stock in trade has caused us a great deal of trouble all through this century. It was introduced as a 'new line' at the beginning of the century and has been of the greatest value, but has suffered from serious fluctuations. The so-called chemical constants, namely, the atomic weights, which should be constants but have not been, have for the larger part of the century been in a humiliating condition of incertitude. But they are improving, settling down to their true values, as it were, and there is cause to take heart of hope concerning them.

Some thirty years ago the Periodic System was announced. The atomic weights had emerged from the slough into which they had sunk by the middle of the century, thanks to the labors of Cannizzaro, Williamson and others, but still there was very little unanimity except with regard to those for which the fewest data were in our possession. It is difficult to select for comparison any representative tables of atomic weights for these earlier years, as none were authoritative. In those days there were no national nor international committees to consider these matters. We shall not go far wrong, however, if we take the list used by Mendeléeff in the construction of his first table and that given by Fownes, whose text-book was very largely used in England and in this country. For the later comparison we will make use of the tables given by the American and German committees. Sixty-three elements come under the comparison in the former case and seventy in the latter. The comparative table follows:

COMPARISON OF LISTS OF ATOMIC WEIGHTS.

	Mendeléeff and Fownes.	American and German.
No. atomic weights differing by less than 0.1	35	46
" " " " " " " 0.1 and less than 0.2	4	9
" " " " " " " 0.2 " more than 0.5	6	11
" " " " " " " 0.5 " " " 1	4	4
" " " " " " " 1 " " " 2	4	..
" " " " " " " 2 " " " 5	5	..
" " " " " " " 5 " " " 10	2	..
" " " " " " " 10 " " " ..	3	..

While much is left to be desired, the improvement is most gratifying. In the earlier tables 55.5 per cent agreed within 0.1 of the value. The majority of these as given in the table were whole numbers and were simply rounded off because the fractions were unknown. The tables of 1899 give 65.7 per cent. of all the elements as agreeing to the same extent, and here the most scrupulous care has been observed in recording the fractional portions. Nearly eighty per cent. of the atomic weights used at present vary by 0.2 or less where in the earlier tables this proportion was only sixty-two per cent. Nearly thirty per cent. of the earlier atomic weights varied by 0.5 or more where only five per cent vary now. None of the present atomic weights vary by more than one whole number where fourteen varied a quarter of a century ago, five of these varying by more than five integers. It is evident that the list is narrowing down and that this blot of ignorance and inaccuracy which has rested upon the science will soon be removed. Few realize how great the army of workers along this line

has been and how much work has been accomplished. About one hundred and fifty new determinations of atomic weights have been made in the last twenty years. Still a great deal more work remains to be done.

F. P. Venable.

University of North Carolina.

HERMAPHRODITISM IN OSTREA LURIDA.

While doing some work for the United States Fish Commission, during the summers of 1897 and 1898, to determine the possibility of propagating Eastern oysters on the Oregon coast, I had an excellent opportunity to study the question of the sex of this West coast oyster. To the best of my knowledge, this question has never been approached hitherto.

During the spawning season of 1897 individuals emitting sexual products which

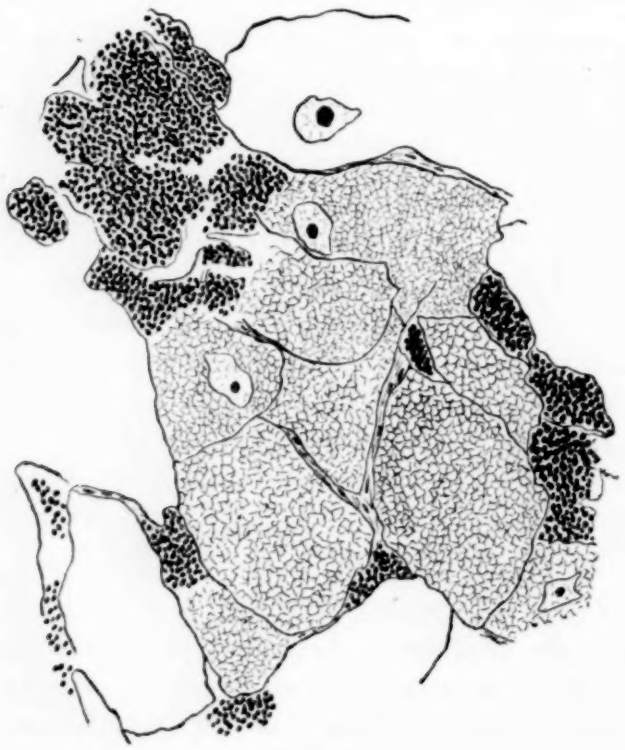

Fig. 1.

proved under a magnifier to be in some cases sperm and in other cases eggs were carefully labelled and separately preserved in different media. As in *Ostrea Virginica*, there is no possibility of mistaking the identity of these sexual products obtained from the visceral mass; even with the naked eye the granular appearance of the eggs is distinct and pronounced, and the thick, creamy consistency of the non-granular male fluid can never be confounded with them.

In my notes for 1897 there is no mention of finding ova mingled with spermatozoa in the examination of living products with the microscope. But, after staining and sectioning a number of individuals, *all of which are labelled males, I almost invariably found ova in the generative follicles*, and amongst them I observed small, deeply-stained bodies in dense masses, which I was led to conclude, even on a preliminary examination, were masses of spermatozoa (see Fig. 1, *Camera lucida* drawing B. & L., O_c 1. Obj. $\frac{1}{6}$). This belief was strengthened on using a $\frac{1}{12}$ hom. imm., by which I could see occasional faint projections from the small bodies referred to, which projections I assumed to be the tails of the spermatozoa, the dots representing the nucleated heads. The finding of ova in these sections was, of itself, startling, for when alive and tested for sex they gave unmistakable evidence of being males. In the figure, which only represents a portion of one generative follicle, four of the ova show germinal vesicles.

This season I gave more particular attention to the microscopic examination of living specimens. The seemingly conclusive results from the study of many individuals is here given. In a specimen of fluid from a male I observed, among free spermatozoa covering the field, collections of sperm cells which I will call 'sperm masses.' Each sperm cell in a mass possessed a tail, and these tails, actively waving to and fro in the salt water under the cover slip, caused the mass to move about. These tails were seen fairly well with a $\frac{1}{6}$ obj. These living sperm masses I regard as identical with the deeply-stained masses seen among the ova

in sections, an example of which is shown in Figure 1. Figure 2 shows free sperm and sperm masses as they appeared in the

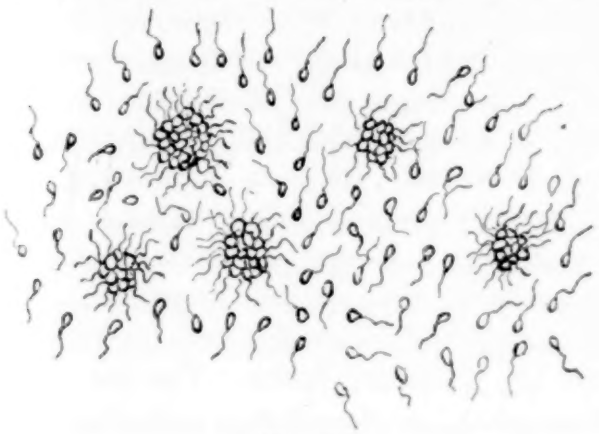

FIG. 2.

field of the microscope. Several oysters, evidently males, were opened with the same results. It yet remained to find living ova in specimens containing spermatozoa in order to more fully support my conclusions as regards the bisexual conditions of this species. This was not difficult, for I shortly discovered in a specimen several immature eggs floating amongst spermatozoa and sperm masses. None of these ova were be-

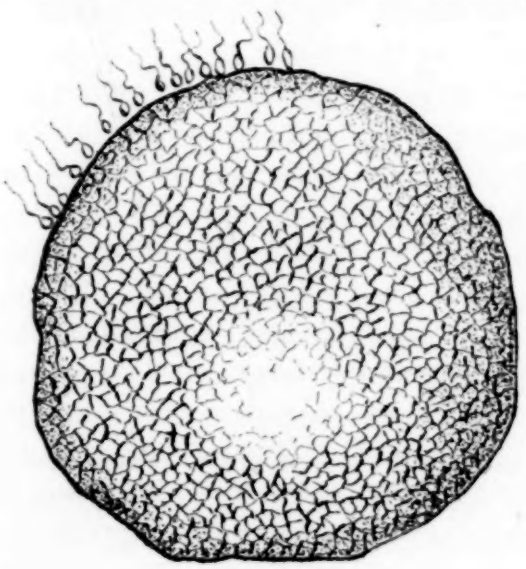

FIG. 3.

ing attacked by the male cells. Later, in a specimen full of spermatozoa, I found a mature egg, completely surrounded by male cells, which were attacking it with great vehemence. Figure 3 (cam. luc. O_c. 1, Obj. $\frac{1}{6}$) shows this egg, the light area evidently denoting the position of the germinal vesicle.

In the drawing only a portion of the periphery is represented as being attacked. We know that in *Ostrea Virginica* the egg does not become round until fertilized. Arguing from analogy the egg shown above has been fertilized.

From the results of the work described above I have no hesitation in declaring that *Ostrea lurida*, the native oyster of the Northwest coast, is hermaphroditic.

In this connection it is interesting to note that Karl Möbius, in 1871, claimed that the sexes of the European oyster, *O. edulis*, are separate at the breeding season (*vide* his 'Untersuchungen über die Fortpflanzungsverhältnisse der Schleswigschen Austern.' In 1877 ('Die Austern und die Austernwirtschaft') he concluded that the sex of the European oyster changes after the reproductive elements have been discharged from the body. He has hardly valid reasons for this conclusion. Professor John McCrady ('Observations on the Food and Reproductive Organs of *Ostrea Virginiana*, with some account of *Bucephalus cuculus*;' Proc. Boston Soc. of Nat. Hist., Dec. 3, 1873) declares that he saw in *O. Virginica*, among small immature ovarian eggs, spermatozoa, separate and in masses, moving about without attacking the eggs and without any apparent change taking place in the young germinal vesicle. *

F. L. WASHBURN.

BIOLOGICAL LABORATORY,
UNIVERSITY OF OREGON, November 16, 1898.

* In connection with Professor Washburn's paper it may be desirable to quote the following note, from the Proceedings of the Academy of Natural Sciences of Philadelphia (1892, p. 351), to which Professor Conklin has called our attention. "*The Hermaphroditism and viviparity of the Oysters of the Northwest Coast of the United States.* Professor J. A. Ryder reported on behalf of Professor R. C. Schiedt of Franklin and Marshall College, Lancaster, Pa., the latter's discov-

AGRICULTURAL ELECTROTECHNICS.

M. Paul Renaud has recently contributed an extensive and valuable paper on applications, effected in Germany, of electrical engineering in the processes of agriculture, and remarks upon its future in France and her colonies.*

An earlier paper had been contributed by the same writer on the subject of agricultural electrical engineering, in which he had endeavored to exhibit the possibilities of such applications, and the present publication has permitted the review of progress to date in realizing earlier dreams and hopes. He proposes, later, to study the progress of this new art and applied science in the United States. In Germany the government has placed its own domains at the disposition of investigators and experimentalists, and the German Society of Agriculture has established exhibitions and competitions resulting in the general dissemination of knowledge thus acquired among its members and agriculturists generally.

In the production of this form of energy the wind has been availed of; the system of M. La Cour permitting the use of windmills by insuring a satisfactory system of regulation of mill and dynamo. Water-power has become the principal source of power in this work in many sections of the country, and its regulation has also been made effective, in some cases, by Reiter's electric brake and governor, as constructed by the Reiter Co., at Winterthur (Switzerland). Like all hydraulic regulators, however, it is costly, its price being about $400.

Recently the gas and petroleum motors are coming into use as prime motors for agricultural work of this character. They are considered to exhibit great advantages over the preceding forms. The use of producer gas ('*gaz pauvre*') is said to give the horse-power at about one-half the cost, in fuel, of the power of the steam-engine, and it requires far less careful or continuous supervision than the latter. Körting, of Körtingsdorf, has taken the lead in the introduction of this system. A double-cylinder gas-engine and direct-coupled generators are usually found most satisfactory. Costs decrease with increase in the proportion of time of operation, and the mean given corresponds to pretty nearly a variation as the fourth root of the annual time of working in hours.

The costs of transmission of the electric energy and of its application in ploughing, in the transportation of merchandise and in other farm operations, are stated as resulting from experience of the character indicated, and it is finally concluded:

1. The electric installation may be employed where a prime motor is already in place, as a steam-engine or a water-wheel, for the purpose of transmitting that energy to the point at which it is proposed, for a time, to perform work, as of operating the plough, centrifugal pumps, etc., in the field, and the various apparatus of the farm, within and without the buildings.

2. The electric plant may be installed at any point found convenient or desirable, as it can be arranged to supply the required power at any point, near or far, over a small

ery of the fact that the oysters native to the northwest coast of the United States are hermaphrodite and viviparous. Specimens from the coast of Oregon and Washington show that the same conditions exist in the reproductive follicles as in those of *Ostrea edulis* of Europe. The presence of eggs and of spermatoblasts and spermatozoa in the same follicle is the invariable rule. The ova, like those of *O. edulis*, are much larger than those of *O. Virginica*, though perhaps not quite so large as the former. The embryos are fertilized in the gill and mantle cavities, where they undergo development."—Ed. Science.

* L'Électrotechnique agricole en Allemagne, son avenir en France and dans nos colonies; par M. Paul Renaud, ingenieur, ancien élève de l'École de Physique et Chémie industrielles de Paris; Bulletin de la Société d'Encouragement pour Industrie Nationale; Paris, Jan., 1899; p. 15.

copper wire at little cost in time, trouble or money.

3. The same motor may be employed for various purposes, successively and at any time, with any forms of agricultural machinery; its small size and portability permitting its transport from one point to another with ease.

4. The facility with which the current may be divided and applied permits its use in driving a number of machines, of various forms, at the same time and in different places.

5. It allows the supply, at the same time, of power for machinery and for light and even for heat.

6. It affords safety against fire, where properly established, and heat, light and power may be thus furnished at minimum risk.

7. The manipulation of the apparatus is simple and easy.

8. This system permits the instantaneous operation of fire-pumps to confine and arrest an incipient fire; it being provided with a suitable system of distributing water mains.

9. By use in prompt suppression of epidemics, by destroying the first cases, extensive contagion and resultant dangers and sacrifices of life and property are avoided.

It is thought that the great sub-division of agricultural lands in France will prevent the introduction of such systems as rapidly as is desirable for the purpose of successfully competing with adjacent countries of Europe. But it remains for the electricians and engineers to secure capital, to distribute electrical energy at low costs, to rent out apparatus and even to see it properly manipulated by furnishing expert operatives, in order that the peasant may not be called upon to provide capital which it is almost impossible for him to find. The agriculturists must combine, form syndicates, and thus make powerful that energy which is powerless in single and separated elements. The great proprietor will find it to his advantage to lead in the introduction of the new systems; setting an example to his neighbors that may later prove fruitful of great good.

In the colonies, it is stated, a spirit of threatening democracy is likely to make them, for a long time, comparatively unproductive, and even the legislators are not always without blame. "They go to their constituents with a cry against machinery which has always been most vehemently raised among these classes, especially against the introduction of machinery for hand-work." The fact is, of course, precisely the opposite, and the introduction of machinery has always benefited the workmen more than other classes. "Augmenting the returns to the proprietor, they permit him to raise the wages of those who continue to work on the soil."

R. H. THURSTON.

SCIENTIFIC BOOKS.

Geology of the Edwards Plateau and Rio Grande Plain adjacent to Austin and San Antonio, Texas, with Reference to the Occurrence of Underground Waters. By ROBERT T. HILL and T. WAYLAND VAUGHAN. From the Eighteenth Annual Report of the United States Geological Survey, 1896–97, Part II.—Papers Chiefly of a Theoretic Nature, pp. 193–321; pl. xxi.–lxiv. Washington, Government Printing Office. 1898.

This is, without doubt, one of the most important contributions to Texas geology in recent years. While the purpose of the authors is primarily to deal with the artesian water problem, they have in reality done much more, as is at once apparent by reference to their complete and detailed descriptions of the geology of this region.

"The artesian wells of the eastern half of Texas belong to several distinct systems, the term 'system' including all wells having their source in the same set of rock sheets or strata. * * * In the Cretaceous formations

alone there are no fewer than five, and two of these—the Travis Peak, or Waco, and the Edwards—receive consideration in this paper."

To those familiar with the Texas Cretaceous a change in nomenclature is at once noticeable—the term 'Travis Peak' being employed for the formation heretofore known as 'Trinity Sands,' and 'Edwards' for the 'Caprina limestone.' These and similar changes are made, as the authors state, by refining the previous nomenclature, appropriate geographic names being substituted wherever possible for paleontologic and mineralogic terms.

An investigation of the source of the artesian water at and in the vicinity of San Antonio was productive of the following results: "That while these well waters come from the same series of beds that supply the artesian wells of the Waco, Fort Worth and Dallas region north of the Colorado, their occurrence presents some important differences of detail. Instead of having their immediate source in beds of porous sands, like the wells about Waco, they are derived largely from the Edwards limestone, hitherto supposed to be one of the most impervious formations of the whole Cretaceous section" (p. 200). "It became apparent," the report continues, "that this hitherto unappreciated water-bearing formation had great possibilities for supplying with flowing or non-flowing wells a large area of country lying between Austin and San Antonio, extending west of the San Antonia River along the northern margin of the Rio Grande Plain towards the Pecos River, and even comprising the extensive summit region of the Edwards Plateau" (p. 200).

Two classes of outflowing waters are recognized—the one following the margin of the Rio Grande Plain, the other appearing in the canyons of the Edwards Plateau.

The introduction which has here been briefly outlined gives but a faint idea of the detailed work which has been so creditably done by the authors.

The geography of the region is now taken up, the chief features of which are the Rio Grande Plain, the Edwards Plateau and its 'jagged southeastward front' called the Balcones Scarp. "Broadly considered, they are a lowland plain inclining gently southeastward to the Gulf of Mexico, an upland plain rising gradually towards the northwest, and a rugged zone of separation which includes a quick ascent from plain to plain."

The Rio Grande Plain is characterized by a low relief, yet attention is called to the fact that occasionally hills of considerable magnitude are encountered; buttes, capped with limestone, or sedimentary below and igneous above; old volcanic necks, as Pilot Knob, south of Austin; rounded masses of basalt, as Sulphur Peak, in Uvalde county. "The Anacacho Hills, extending east and west in southern Kinney county and constituting the most rugose part of the plain are of still another type, consisting of a monoclinal plateau, or cuesta, sloping southward and presenting a steep scarp to the north."

Climatically the plain may be divided into the eastern, or humid and sub-humid region and the western, or arid region. Beyond Bexar county continuous cultivation is impossible on account of aridity.

The Balcones Scarp, the position of which "is determined by a complex dislocation of the rocks, the Balcones fault," is the dissected edge of the Edwards Plateau. Numerous hills of denudation, locally known as mountains, here rise above the Rio Grande Plain—in the vicinity of Austin, 400 feet; in Uvalde county, 1000 feet.

The elevated Edwards Plateau merges into the Llano Estacado. Between them there is no definite line of separation, yet their surface characters, soil and rocks, give to each a peculiarity of its own.

The main drainage of the Edwards Plateau is to the east and southeast, and, as its watershed lies well to the westward, the erosion of the streams flowing into the Pecos is but moderate.

The observer in crossing the Balcones line "experiences a sudden and complete change of scenery, with accompanying changes in floral, geologic and cultured conditions." Three simple topographic elements are presented, viz.: "The flat-topped summits of the decaying plateau; the breaks or slopes of its crenulated borders and canyoned valleys; [and] the stream ways."

The cap-rock of the plateau is the Edwards (Caprina) limestone.

As the streams of this region have an important bearing upon the underground flow of water, the Rio Frio has been selected as a type and described in detail. "The caletas and upper canyons are usually dry and waterless arroyos, except in time of storm. The flat-bottomed canyons contain permanent pools of flowing water, fed by springs and on the lower plain the running water disappears entirely or for a considerable distance."

Brief mention is also made of the caverns of the plateau, as they likewise are concerned with the question of underground waters. Three types are recognized: "(1) small cavities within individual limestone strata, giving them what is locally termed a honeycombed structure; (2) open caverns occuring in certain bluff faces along the stream valleys; (3) underground caverns of vast extent dissolved out of many strata."

The flora is next discussed. It presents three phases: that of the stream bottoms; "that of the breaks, and that of the summit." Among the interesting facts recorded mention may be made of one: the occurrence of the cypress. "This tree, which ordinarily grows only in the swamps and bayous of the low subcoastal regions, attains an enormous size at the edge of the deeper holes near the heads of permanent water of the Pedernalis, Blanco, San Marcos, Guadalupe, Cypress, Onion Creek and other streams. These localities are at altitudes from 1,000 to 1,750 feet above the sea, and hundreds of miles west of the great cypress swamps of the eastern tier of Texan counties, with which they have no possible continuity. * * * *

"Before entering upon the geology of the region a few pages are devoted to a statement of 'the general principals of artesian waters.' Under the caption 'Capacity of Rocks for Absorbing Moisture' the following succinct statement is given concerning the water-bearing strata of Texas: "The artesian water-bearing strata of the State east of the Pecos River are composed mostly of extensive sheets of sands, clays and limestones, succeeding one another in orderly arrangement, except along the Balcones zone of faulting, and in general having a gentle inclination towards the sea, so that in travelling northwestward, although constantly ascending in altitude, one encounters the outcropping edges of rock sheets of lower and lower stratigraphic position. This produces the simple arrangement of a tilted plain built up of a series of alternately impervious and pervious layers. The rain falling upon the outcropping edges of the latter sinks into the embed and by gravity is conducted seaward down the plain of its inclination to lower levels beneath the surface. Each different stratum, including any particular water-bearing stratum, becomes embedded deeper and deeper to the southeastward of the point where it outcrops at the surface."

The rocks appearing in the region under discussion are tabulated as follows:

"RECENT.	
Wash deposits of the hillsides, stream-bed material, etc.	
PLEISTOCENE.	
Onion Creek marl; Leona formation, and other terrace deposits.	
PLIOCENE.	
Uvalde formation.	
EOCENE.	
CRETACEOUS.	
Gulf Series.	
Webberville and Eagle Pass formations	Montana division.
Taylor and Anacacho formations.	
Austin chalk	Colorado division.
Eagle Ford shales	
Comanche Series.	
Shoal Creek limestone	Washita division.
Del Rio clay	
Fort Worth limestone	
Edwards limestone	Fredericksburg division.
Comanche Peak limestone	
Walnut formation	
Glen Rose formation	Trinity division."
Travis Peak and allied formations	

Most of the above formations are minutely described, especially the Cretaceous, and many measured sections given. The carefully executed work about Austin will be extremely valuable to students, as that locality affords a most inviting field for study.

The chemical lime deposits merit a line in passing. In many parts of Texas, where the country rock is chalky, some of the calcareous matter is evidently redistributed through the

agency of rains. By the subsequent evaporation of the water a superficial cement or crust is formed which may involve pebbles distributed over the surface—this is 'tepetete.'

The igneous rocks of the Rio Grande Plain occur 'along the interior margin.' They are basic. The rock from Pilot Knob has been described as nephaline-basalt.*

The arrangement of the strata is next considered. The Cretaceous rocks are shown to have great persistency, while their dip towards the coast is but slight. The Balcones fault zone has already been mentioned as forming the 'abrupt southern termination of the Edwards Plateau.' "The strata on the seaward side of the faults have been dropped down, so that any particular stratum—the top of the Edwards limestone, for instance—lies 500 to 1,000 feet lower on the coastward or downthrow side of the fracture than on the interior or upthrow side." It should, however, be borne in mind "that the fault zone really consists of many faults, having subparallel directions all concentrated in a narrow belt of country." The displacement at Mt. Bonnell, on the Colorado above Austin, is such that the Eagle Ford shales of the Gulf series are brought in contact with the Glen Rose beds of the Comanche series.

Our authors now enter upon a discussion of the water capacity of the various rock sheets. The impervious layers are, of course, non-water-bearing, and to this class, south of the Colorado River, belong nearly all the Cretaceous rocks above the Edwards limestone. On the other hand, "rocks of open texture, such as sands, conglomerates, porous and chalky limestones, and massive rocks broken by joints, fissures, honeycombs or other openings, are usually water-bearing. These are mostly found below the Del Rio clay." The proof of the water-bearing property of the Edwards limestones is supplied by the "great springs * * * bursting out of them at the head waters of the Llano, Guadalupe, Frio and Neuces Rivers;" by the artesian well records at Manor, San Marcos and San Antonio, and by the ordinary wells of the Edwards Plateau. The distribution of water is facilitated also by the honeycomb and cavernous character of certain limestone layers. The opinion is expressed that the Travis Peak and Gillespie formations, at the very base, contain "a greater quantity of water than any other beds of the Comanche series."

The underground water of the region is next taken up: (1) The waters of the Edwards Plateau; (2) The waters of the Rio Grande Plain. In many instances non-flowing wells, springs and artesian wells receive detailed treatment; of the latter logs are frequently given, as in the case of the Austin wells, the San Marcos well, the Manor well and those of San Antonio. Under the chemical qualities of the waters mention should be made of the excellent analyses of waters from Austin and vicinity, made by Dr. Henry Winston Harper, of the University of Texas.

Of the fissure springs, those at San Marcos, San Antonio, New Braunfels, Austin, etc., are well known. On p. 311 is given a table of the discharge of the various spring rivers, the San Marcos reaching 57,522,200 gallons in twenty-four hours, and the Comal 221,981,932 gallons in the same time. From a study of the strata and their faulting the authors conclude that "these waters come from the deep-seated rocks and are forced to the surface by hydrostatic pressure. Hence they are artesian in nature and constitute natural artesian wells." Taking into consideration the color, taste, temperature, volume, freedom from sulphuretted hydrogen, the conclusion is reached that "their water is derived from either the 'sweet water' horizon of the Edwards formation or the Travis Peak sands, that is, they have the same source as the purer waters of the artesian wells."

As to the source of the underground waters, the fact that the Pecos breaks the continuity of the strata renders it impossible, as the authors point out, to consider the Rocky Mountain region in this connection. They contend, on the other hand, that the Plateau of the Plains is the real source; that "much of the rain water is caught directly upon the edges of the Glen Rose and lower beds which outcrop along the western and northern summits, breaks and margins of the Plateau * * * at an elevation higher than that of their embedded continuation along

* J. F. Kemp. See Pilot Knob: 'A Marine Cretaceous Volcano,' by Robt. J. Hill and J. F. Kemp. *Amer. Geologist*, Vol. VI., 1890, p. 292.

its eastern and southern margin." Of the rainfall on the Edwards Plateau a large part must reach the water-bearing strata by percolating downward.

By the Balcones faulting, however, the continuity of the beds is broken on the southeast and south; hence the contained water must either escape through fissures, forming fissure springs, or be forced into the porous beds underlying the Rio Grande Plain—beds which occupy a different position in the geologic column, as, for instance, the porous Edwards limestone abutting the water-bearing Glen Rose beds.

The report is enriched with many excellent plates, not to mention maps and diagrams. Of the former, fourteen illustrate the characteristic fossils of the principal formations encountered in drilling for artesian water.

FREDERIC W. SIMONDS.
UNIVERSITY OF TEXAS.

A Handbook of Medical Climatology: Embodying its Principles and Therapeutic Application, with Scientific Data of the Chief Health Resorts of the World. By S. EDWIN SOLLY, M. D., M. R. C. S., Late President of the American Climatological Association. Philadelphia and New York, Lea Bros. & Co. Illustrated. Cl. 8vo. Pp. 470. Price, $4.00.

This work is a systematic treatise on climate in its medical relations. It affords precise information with reference to health resorts, enabling physicians and their patients to obtain unprejudiced reports as to localities without reliance on the scattered and often unreliable data hitherto available.

The first two sections deal with the principles of medical climatology; the effect of cold; humidity; perspiration; barometric pressure; the effect of climate as seen in different races of men; and the geographical distribution of disease.

The application of climate to the treatment of phthisis forms an important chapter of seventy pages. It bears evidence of the author's large experience with this affection. The effect of climate on other organs besides the lungs is also included.

We believe it would have been wiser not to have attempted to cover the entire globe in the treatment of this extensive subject. The portion devoted to the United States is ample so far as it relates to the Rocky Mountain Region and the Pacific Slope. It is presented in such an attractive manner that we wish that the Eastern and Middle States had been more fully exploited. At least a paragraph on Atlantic City and Cape May might well have been added, not to mention other resorts on the New Jersey coast. Bedford Springs and Glen Summit, in Pennsylvania, seem to have escaped the author's attention. In a work of this kind sins of omission are almost inevitable, and it is difficult to make the text so even as to satisfy critics from every locality. We do not know of any one better qualified to discuss the intricacies of the American climates than Dr. Solly; certainly no one hitherto has presented the subject in so attractive and useful a volume.

G. HINSDALE.

SCIENTIFIC JOURNALS AND ARTICLES.

THE first number of the *American Anthropologist*, new series, to the plans for which we have already called attention, has been issued by Messrs. G. P. Putnam's Sons. The number, which contains 200 pages and 10 plates, is made up as follows:

Powell, J. W. Esthetology, or the Science of Activities designed to give Pleasure.

Brinton, Daniel G. The Calchaqui: an Archeological Problem.

Mason, Otis T. Aboriginal American Zoötechny.

Fletcher, Alice C. A Pawnee Ritual used when changing a Man's Name.

Boas, Franz. Some Recent Criticisms of Physical Anthropology.

Holmes, W. H. Preliminary Revision of the Evidence relating to Aurifereus Gravel Man in California. (First Paper.)

Brinton, Daniel G. Professor Blumentritt's Studies of the Philippines.

Mooney, James. The Indian Congress at Omaha.

Hough, Walter. Korean Clan Organization.

Gatschet, A. S. 'Real,' 'True,' or 'Genuine' in Indian Languages.

Tooker William Wallace. The adopted Algonquian term 'Poquosin.'

Anthropologic Literature.

Current Bibliography of Anthropology.

Notes and News.

Mr. F. W. Hodge is secretary and managing editor, and the editorial board consists of Frank Baker, Smithsonian Institution, Washington; Franz Boas, American Museum of Natural History, New York; Daniel G. Brinton, University of Pennsylvania, Philadelphia; George M. Dawson, Geological Survey of Canada, Ottawa; George A. Dorsey, Field Columbian Museum, Chicago; Alice C. Fletcher, Harvard University, Cambridge; W. H. Holmes, U. S. National Museum, Washington; J. W. Powell, Bureau of American Ethnology, Washington; F. W. Putnam, Peabody Museum, Cambridge. The journal, published quarterly, at a cost of four dollars a year, deserves the support of all interested in anthropology, as it will accomplish much for the science, which is now making such great advances.

The first article in the *American Naturalist* for March is by Professor J. P. McMurrich, on 'The Present Status of Anatomy;' various advances in the study of anatomy are described, and a strong plea made for the study of comparative anatomy as an aid to the understanding of human anatomy. Dr. Erwin F. Smith records 'The Second Annual Meeting of the Society for Plant Morphology and Physiology,' and submits abstracts of the papers presented. Professor J. S. Kingsley and W. H. Ruddick discuss 'The *Ossicula Anditus* and Mammalian Ancestry,' deciding, as the result of their observations, that the incus has been correctly regarded as the quadrate. The probability of an amphibian origin for the Mammals is favorably considered. Professor Harris H. Wilder treats at some length of *Desmognathus fusca* (Rafinesque) and *Spelerpes bilineatus* (Green), two species often confused with each other, particularly in their larval state. The habitat and development of each is described. 'The Poisons Given Off by Parasitic Worms in Man and Animals' are briefly noted by Dr. G. H. F. Nuttall, who considers that this is a fruitful field for research. Dr. Leonhard Stejneger describes 'A Curious Malformation of the Shields of a Snake's Head,' whereby the scutellation was completely changed. Among the editorials one protests against too strict an adherence to the laws of priority. The many readers of the *Naturalist* will note with pleasure that the table of contents is provided with page references.

The leading article of the April *Monist* is on 'The Primitive Inhabitants of Europe,' by Professor G. Sergi, of Rome, and sets forth the criteria which this anthropologist has established for distinguishing race-types. The monumental work of Mr. Shadworth H. Hodgson, 'The Metaphysic of Experience,' is discussed at length by Dr. Edmund Montgomery. Mr. William Romaine Paterson contributes an article on 'The Irony of Jesus,' in which the intellectual and critical side of the great Teacher is emphasized. Dr. Paul Carus has a study in comparative religion, called 'Yahveh and Manitou,' in which he draws a parallelism between Yahveh, the Israelitish God of the desert, and the great deity of the North American Indians. Professor L. Lévy-Bruhl, of Paris, offers a study of 'The Contemporaneous Philosophy of France,' and Lucien Arréat his usual critical review of current French philosophical and scientific literature. The book reviews of the number deal mainly with works on the philosophy of science, mathematics, physics, and so forth.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON, 303D REGULAR MEETING, SATURDAY, FEBRUARY 25.

Mr. H. J. Webber spoke of some recent researches in the development of *Cobæa scandens* which exhibited a hitherto unknown method of spindle formation.

The remainder of the evening was devoted to a discussion of the features of the Great Dismal Swamp. Dr. W. H. Seaman described the peculiar method of getting out lumber by digging a small ditch, just large enough to accommodate a single log. He also stated that a sample of the clay underlying the lake showed no diatoms.

Mr. F. D. Gardner presented some further remarks on the soils, saying that the reclaimed land was extremely good for raising corn, as the amount of rainfall during the critical month of August is about twice that of the Western corn belt.

Mr. F. V. Coville noted the importance of

the lake as a feeder for the Dismal Swamp canal and also as a possible source of water supply for Norfolk. The cleared land was said to be well adapted for truck farming, while the cypress and juniper lumber was also available, and the latter, being of rapid growth, could be cultivated.

Mr. William Palmer spoke further on the physiographic features of the region and of the animals, stating that the swamp lay near the northern limit of many Southern species. The Prothonotary Warbler was said to be abundant, and the manner in which the Chimney Swifts bred in the hollow cypresses was described.

Mr. Vernon Bailey noted the occurrence of such Northern forms as the Shrew, Star-nosed Mole and the Lemming Mouse.

Dr. A. K. Fisher spoke of the manner in which the sphagnum pushed out into the ditches, and drew attention to the fact that the removal of the dam at the entrance of the canal feeder would drain the lake, as the canal had been dredged out some distance from the shore.

Professor Lester F. Ward gave an account of a visit to the swamp in 1877.

O. F. COOK,
Recording Secretary.

THE WASHINGTON BOTANICAL CLUB.

THE fourth regular meeting was held at the residence of Mr. A. J. Pieters, March 1, 1899.

Mr. T. A. Williams, in discussing 'New or Interesting Lichens,' exhibited specimens of *Omphalodium Arizonicum* Tuckerm., and reported the collection of this rare lichen in the White Mountains of New Mexico, by Professor E. O. Wooton, this being the second time that the species has been obtained by collectors. The original specimens were discovered by C. G. Pringle in Arizona. The validity of the genus *Omphalodium* was discussed, and the opinion expressed that it was abundantly distinct from *Parmelia*. Specimens were also shown of four new species of lichens belonging to the genera *Siphula*, *Lecanora*, *Gyalecta* and *Omphalaria*, with comments on their distinguishing characters and relationships.

Mr. Frederick V. Coville gave a systematic review of 'The Currants and Gooseberries of Southeastern Oregon,' exhibiting many specimens and explaining the differentiation of species from aggregates, such as *Ribes divaricatum* and *R. lacustre*.

Mr. Pieters exhibited a gigantic specimen of *Lophotocarpus calycinus* from the shores of Lake Erie, commenting on its eastern extension.

CHARLES LOUIS POLLARD,
Secretary.

THE NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY.

THE regular monthly meeting of the New York Section of the American Chemical Society was held on Friday evening, the 10th inst., at the Chemists' Club, 108 West Fifty-fifth street, Dr. Wm. McMurtrie presiding and eighty-five members present. Dr. Doremus made a special announcement of the annual exhibition of the New York Academy of Sciences, and urged any members having new and interesting material to contribute the same to the exhibits.

The following papers were then read:

1. Frederick S. Hyde, 'Preparation of Graphitoidal Silicium.'

2. W. O. Atwater, 'The Conservation of Energy in the Human Body.'

3. Joseph F. Geisler, 'Paraffin as an Adulterant of Oleomargarine.'

4. L. H. Reuter, 'Manufacture of Pure Phenyldimethylpyrazolon-sulphonic Acid.'

5. L. H. Reuter, 'Manufacture of B Naphthalene-sulphonic Acid and Benzoyl-sulphonic Acid for the Manufacture of Ether.'

6. A. Bourgougnon, 'On the Determination of Sulphur in Sulphites.'

While the first paper was before the meeting, the President of the Society, Professor E. W. Morley, of Cleveland, arrived, and was invited to take the chair. He made a few remrks on the interest taken in the Section by its members, as evidenced not only by the full attendance and interesting list of papers to be read at this meeting, but by the uniformly high character and abundance of material announced for each and every meeting.

Professor Atwater stated that the large calorimeter chamber, in which a man can live for a week or more at a time, has been so perfected that an analysis of pure alcohol by combustion can be made in it to within 0.1 per cent. of the

theoretic composition. The results on the calorific value of foods as consumed in the human body agree very closely with the results calculated from experiments with the bomb calorimeter. The chief difficulties at present are in regard to certain constants, as, for instance, the value of the calorie, the latent heat of evaporation of water at different temperatures, etc. The calculation of the observations from a week's run of the calorimeter chamber is itself an arduous and exacting piece of work. Thus far the law of the conservation of energy in the human body is fully demonstrated, within a very small error, which it is hoped to eliminate entirely.

J. F. Geisler exhibited a sample of paraffine extracted from adulterated oleomargarine, which contained about 45 grains of the wax per ounce.

Samples had been purchased in New York and vicinity containing from 5 to 11.75 per cent. paraffine.

DURAND WOODMAN,
Secretary.

SECTION OF ASTRONOMY AND PHYSICS OF THE NEW YORK ACADEMY OF SCIENCES,
MARCH 6, 1899.

ANNUAL election of officers was held, and Professor M. I. Pupin elected Chairman, and Dr. W. S. Day, Secretary, to serve for the ensuing year.

Professor J. K. Rees described the great horizontal telescope for the Paris Exposition in 1900. This instrument is to have a focal length of 66 meters, and is placed horizontally, on account of the great difficulty of building and moving a dome large enough for it, if mounted in the usual manner. A plane mirror is mounted so as to be capable of motion in any direction, in order to reflect the light of a star into the tube. The object glass is 49 inches in diameter. A number of lantern views of the Yerkes telescope were shown. This, when the Paris instrument is completed, will no longer be the largest in the world.

Dr. P. H. Dudley read a paper entitled: 'Stresses in Rails due to Thermal Changes,' in which he showed that most fractures of rails occur on a decided fall of temperature, because the rails, held very tight by the bolts in the splice bars, are strained by the contraction beyond their tensile strength; while on a rise of temperature the expansion of the rails puts them under a stress of compression; and apparently the factor of safety of the steel is not so much reduced under compressive as under tensile stresses.

R. GORDON,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science of St. Louis on the evening of March 20, 1899, fifty-three persons present, Dr. T. J. J. See delivered an address on the 'Temperature and Relative Ages of the Stars and Nebulæ.' The address, which developed quite fully the temperature equation, was discussed at some length by Professor C. M. Woodward. A paper by Professor L. H. Pammel, on 'Anatomical Characters of the Seeds of Leguminoseæ,' was presented by title.

Two persons were elected to active membership.

WILLIAM TRELEASE,
Recording Secretary.

DISCUSSION AND CORRESPONDENCE.

PLYMOUTH, ENGLAND, AND ITS MARINE BIOLOGICAL LABORATORY.*

PLYMOUTH is a place of great natural beauty and more undulating than any city with which I am familiar. It has a population of about 200,000 and is a seaport of much importance, many of the Oriental and Australian steamships touching here. It contains one of the largest navy-yards and garrisons in England. In one respect it is unique, as far as my experience goes, for the city touches the harbor at its eastern and western extremities only, the central part being separated from the water-front by a high open hill called Hoe Park. The rising face of this hill is tastefully laid out as a park, while on the summit is an asphalt promenade 150 feet wide and extending for half a mile.

* In a recent private letter to a friend, Dr. Edward G. Gardiner gives an account of Plymouth, its Laboratory, its winter climate and other matters, which it is believed many readers of SCIENCE will be glad to have for reference.

From this high platform the land falls rapidly toward the sea, but the grassy slope is broken here and there by terraced paths and drives and the sea breaks at the base on rugged limestone cliffs. Nestled among the nooks and crannies of the rocks are various public bath-houses, and until the end of November numerous bathers might be seen diving, swimming or sunning themselves like seals on the rocks. These rocks constitute a most beautiful piece of cliff scenery, and from the top of the promenade the view is magnificent. Northward lie the hills of the city and beyond these the wild uplands of Dartmoor; to the south, at one's feet, lies the harbor with all its busy shipping, red-sailed fishing craft and strange looking warships. The harbor, or 'sound,' as it is called, is a bay, roughly speaking rectangular in shape, some three miles deep and about as broad, bounded by headlands upwards of four hundred feet high, falling abruptly, and in many places precipitously, to the sea.

Official documents state that the defences of this sound include fourteen miles of fortifications, and as many of these are on the headlands their towers, angles and projections break the sky line and add interest and beauty to the scenery. The entrance to the sound is protected by a breakwater (on which is a lighthouse and a fort) a mile in length, thus converting what must have been but a wild and dangerous anchorage into a safe harbor. A few days ago we had a southwester which broke the record. The harbor was full of shipping, and it was interesting to stand on the Hoe in a sheltered place and see the havoc. A good deal of damage was done, but no lives were lost. The word 'Hoe,' I am told, is an old name for 'Hill,' and is common along this coast, for example, Plymouth Hoe, School Hoe, Stedcombe Hoe, Mort Hoe, Croyte Hoe, Martin Hoe, etc., along the coasts of Devon and Cornwall. Moreover, there are numerous 'Holes' along this coast, Rent's Hole, Croft Hole, Mouse Hole, Hole's Hole, Butter Hole, Daddy Hole, Kent's Hole, etc. Speaking without any philological knowledge whatsoever, I more than suspect that 'Hoe' and 'Hole' may originally have been the same word, though I have not found any very competent authority on which to rest such a theory. What first suggested it was the fact, generally accepted hereabouts, that Hoe means hill, and in the discovery that at least two of the above-mentioned Holes were hills where there are no 'holes' (or harbors) in the land. Whatever the origin of Hole may be, it is interesting to note that both Hoe and Hole are 'west-country' names, *i. e.*, belong to Devon and Cornwall. The only 'Holes' on the New England coast, so far as I know, are in southern Massachusetts, and in that part of the State are also Plymouth, Falmouth, Dartmouth, Truro, etc., all Devon and Cornish names, and the association of these with Wood's Hole, Holmes' Hole (now Vineyard Haven), Quick's Hole, and the like, is interesting.

Directly under the walls of an old iron-clad fortress which crowns the southern end of the Plymouth Hoe stands the Laboratory of the Marine Biological Association of Great Britain. Between the Laboratory and the fort—a distance of fifty yards—are a garden and tennis-court, while the sun reflected from the limestone wall beyond has all the value for microscopic work of a white cloud perpetually anchored in the right place. Those who built the fort did not know what good work they were doing for naturalists. On the other side of the Laboratory the land falls away abruptly to the sea. The designers of the Laboratory building had no idea, however, of exposing the naturalist when armed with dip-net and bucket for a collecting trip to the gaze of the curious public, for a cleverly constructed tunnel leads from the basement under the foot- and driveway directly to the cliffs whence a path winds downwards to the boat-landing and the beach.

The Laboratory building is a handsome stone structure 179 feet long. The central part, 70 x 34, is two stories in height, while at each end the remaining portion is higher and broader, thus giving an effect of low, flanking towers. In one of these towers is the residence of the Director, while in the other are rooms for the engineer, caretaker, etc., on the lower story, and in the second, chemical laboratories and supply department, with the library above in the third story. The library is a charming room, having two open fireplaces and offering a view which is so attractive as seriously to interfere with hard

work. The library contains about 1,500 volumes, and it is not difficult to obtain books from elsewhere when necessary.

On the ground floor of the central portion of the building is an aquarium well stocked from the native fauna and open to the public for a small fee. Above the aquarium is the main Laboratory, a well-lighted and well-ventilated room of moderate height, 70x34. The windows, which are very large, are separated by partitions about seven feet high, forming a series of alcoves, each about ten feet square. Through the center of the Laboratory runs a continuous line of aquaria designed for experimental work. The whole place is clean, orderly and well kept (except, of course, my own alcove), and as good a place for work as could be desired. Every investigator is given a pass-key to the Laboratory, which is available for work day or night and every day precisely as one wishes or as his work requires. Smoking is allowed everywhere, which is a luxury to me, for you may remember that an occasional cigarette is necessary for my health.

The staff consists of three naturalists, including the Director, and eight employees, such as janitor, boatman, Laboratory *Diener*, etc. The latter is well trained in the art of preserving marine animals in the expanded condition, in the art of mixing reagents, and the like. The Laboratory is provided with a steamer about 60 feet long and with a sail-boat, both of which are kept well employed collecting for the supply department, so that there is an abundant supply of fresh material constantly brought in. In the Official Reports of the Laboratory stress is naturally laid on its needs. Some with whom I have talked have seemed to interpret these appeals as signifying extreme poverty, and are surprised accordingly to find an establishment so well equipped. It is not, of course, perfect, but, in my opinion, it is an excellent laboratory, admirably managed.

In the university vacations the place, I am told, is full of workers, but during the present winter there have been in residence only the three naturalists on the staff and three other investigators besides myself.

I have read of the severe winter at home with many chuckles of satisfaction that I am not in it, for, as you know, I have no affection for our blizzards, and I am contented that they are unknown here. The lowest temperature recorded this winter at Plymouth was 29° F. on what the newspapers called a 'bitter cold night,' and the highest during January was 56°. As a rule, it has been 45° or thereabouts. We have a good deal of rain, but, by a fortunate meteorological arrangement, it is rarely cold and stormy at the same time. The south and southwest winds are mild and rainy and the easterly and northerly winds clear and cool. The winds are so tempered that sheep graze in the public parks all winter, while on tennis-courts, and on lawns where sheep are not allowed, lawn-mowers have been in constant use to keep the grass under control. Many of the more hardy garden plants bloom all winter, and the ivy and numerous shrubs are luxuriant with greenness. Spring is already at hand (February 17th), as is apparent from the wild violets and primroses, blossoms of which I have picked in the fields this week. One day it snowed for two hours, but at the end of that time there was no snow to be seen, every flake having melted as it fell.

Of course, the people exercise the right of all free men to grumble at the weather, but I have seen many climates which gave far more cause for grumbling. There is a widspread impression, which I suspect may be correct, that the big storms here are hatched on our side of the Atlantic and find their way across. Whenever we get a good strong southwester people say with an injured air, 'See how the Americans treat us,' almost as if there were personal spite in it. On the whole, the climate is to me infinitely more agreeable than that of New England.

To sum it all up, Plymouth and its surroundings are beautiful; the climate is (to me) agreeable; my family has been in most excellent health all winter; and, lastly, the Laboratory is a most delightful place for work.

THE DUPLICATION OF GEOLOGIC FORMATION NAMES.

The custom of giving more or less local geographic names to geologic sub-divisions has become so universal that we are even now duplicating the use of such names to a considerable

extent. Geological literature is of too great bulk for the working geologist to attempt to ascertain whether or not names which he proposes to use have been preoccupied. To illustrate what the present system is leading to, a few instances of some prominence will be cited.

In 1883 Hague described, in a report of the U. S. Geological Survey, the Eureka quartzite, a sub-division of the Silurian, in the Eureka district, Nevada. In 1891 Simonds and Hopkins, in a report of the Arkansas Geological Survey, used the name Eureka shale for a supposed Devonian horizon; while in 1898 Haworth, in a report of the Kansas Geological Survey, proposes the name Eureka limestone as a subdivision of the Coal Measures.

In 1879 Peale, in the 11th Annual Report of the U. S. Geological and Geographical Survey of the Territories, employed the term Cache Valley Group for a sub-division of the Pleistocene of Utah. Becker described, in 1888, the Cache Lake beds of California, in Monograph XIII of the U. S. Geological Survey, and referred them to the Tertiary. In 1896 G. M. Dawson, in a report of the Canada Geological Survey, uses the name Cache Creek formation for an horizon of the Carboniferous to include strata described by Selwyn in 1872 as Upper and Lower Cache Creek beds.

In 1842–46 Emmons, Vanuxem and Mather employed, the term Erie division as a sub-division of the New York system. In the Ohio Geological Survey reports, the Erie clay was used as a sub-division of the Pleistocene, and Erie shale was referred both to the Carboniferous and Devonian. In 1875 Lesley described, in a report of the Pennsylvania Geological Survey, the Erie shale, which he referred to the Silurian. In 1898 Haworth described the Erie limestone of the Coal Measures of Kansas. The above references are given merely to illustrate the confusion that is likely to arise from use of new geographic terms if the literature is not carefully examined for previous use.

For the past eighteen months the writer has been engaged in preparing a card catalogue of geologic formation names, during such time as could be taken from other office and field work. This catalogue has already assumed considerable proportions, and is now being consulted by those geologists who are aware that such a work is being prosecuted. While preparing the annual bibliography of geological literature for 1898 the writer has found several instances of duplication of names that have become well established in geologic nomenclature. It will probably be a year or more before this catalogue can be published, and, in the meantime, to assist in avoiding such duplication, the writer offers to furnish geologists who will correspond with him such information as he possesses regarding names which they propose to use as formation names.

F. B. WEEKS.

U. S. GEOLOGICAL SURVEY,
WASHINGTON, D. C.

THE BERLIN TUBERCULOSIS CONGRESS.*

THE German Central Committee for the erection of Sanitaria for Consumptives have issued a call for a Congress to be held in Berlin, Germany, May 24–27, 1899, for the purpose of discussing the subject of tuberculosis. The Congress will meet in the new building of the Imperial Diet and is under the patronage of Her Majesty, The Kaiserin, while Prince Hohenlohe, the Imperial Chancellor, will serve as Honorary President. All of the German States, also local authorities, medical faculties and societies, and all corporations interested in fighting tuberculosis, have been requested to send delegates, and all foreign countries represented at the Imperial Court have also been invited to take part. The United States Embassy has been requested to extend a cordial invitation to American physicians to become members of the Congress, and the same invitation has been extended through other missions to physicians of other nationalities.

As a basis for discussion papers will be presented as follows: (1) 'Distribution and extent of tuberculosis' by Geheimrath Koehler, Director of the Imperial Health Office, and Geheimrath Krieger, of Strassburg; (2) 'Etiology,' by Professors Robert Koch and B. Fraenkel, of Berlin; (3) 'Prophylaxis,' by Pro-

* Written at the request of Dr. Pannwitz, General Secretary of the Congress, and forwarded simultaneously to several American journals. The medical, veterinarian and scientific press is requested to call the attention of its readers to this Congress.

fessor Gerhardt and Generaloberartzt Schjerning, of Berlin; (4) 'Therapy,' by Professor von Ziemssen, of Munich, and Professor Schroetter, of Vienna; (5) 'Sanitaria,' by Herr Gaebel, President of Imperial Insurance Office, Berlin, and Dr. Dettweiler, of Falkenstein.

Following the presentation of the two leading papers (limited to 20 minutes each) in the respective divisions, there will be a general discussion, speakers being limited to 10 minutes each. All papers and remarks are to be in German, although the chairman is empowered to make exceptions during the general discussion.

All persons interested in the subject of tuberculosis are eligible for membership; membership cards (20 Marks, nearly $5) are to be obtained at the office of the Congress ('Bureau des Organisations-Komites, Wilhelm Platz 2, Berlin, W') and entitle the holder to a copy of the 'Proceedings.' An early registration is requested.

The writer has been requested to furnish a list of Americans to whom special invitations to the Congress should be sent. He has complied with this request, so far as his personal and professional acquaintance with specialists in this line has permitted, and has also suggested to the committee that invitations be sent to the various medical societies and faculties. There are undoubtedly many American practitioners especially interested in tuberculosis and possibly some laboratory workers whom he has overlooked. Should any such person desire to attend the Congress, yet prefer to receive a personal invitation, the writer will be pleased to forward the name of such persons, upon proper introduction, to the Executive Committee of the Congress. As 'proper introduction' will be considered a letter from any recognized medical, scientific or veterinary faculty or society.

Ch. Wardell Stiles, Ph.D.,
Scientific Attaché, U. S. Embassy, Berlin, Germany.

ASTRONOMICAL NOTES.

The Rutherfurd Photographs.

Among recent additions to the literature of the astronomy of precision are four contributions from the Observatory of Columbia University which give the results of measurements of the Rutherfurd plates. Dr. Davis contributes three of these, entitled 'Catalogue of Sixty-five Stars Near 61 Cygni,' 'The Parallaxes of 61^1 and 61^2 Cygni,' 'Catalogue of Thirty-four Stars near Bradley 3077.' Mr. Schlesinger contributes the fourth, upon 'The Præsepe Group.' All these are most admirable illustrations of the highest type of astronomical work in the determination of exact positions of the stars, and careful deductions therefrom. No pains have been spared to make the original measures under such conditions that the instrumental constants shall be well determined, and all corrections and reductions accurately applied. The result is three catalogues of stars whose coordinates relative to the reference star in each group are determined with great precision. The two catalogues of stars near 61 Cygni and Bradley 3077 are for the purpose of discussing the parallaxes of these well-known stars. The most interesting result of Dr. Davis's discussion is the well-marked difference of parallax between 61^1 and 61^2 Cygni, determined from both position angles and distances, the numerical amount of which is $0''.072 \pm 0''.028$. This large difference, if real, explains the failure of double-star observers to detect any evidence of orbital motion, and would show that the stars do not form a binary system. A confirmation of this conclusion is found in a careful discussion of Wilsing's determinations of the distance of these two stars, which gives $0''.0876$ for the difference. The mean of the different determinations of parallax for the stars made by other astronomers shows a difference of $0''.082$, which confirms further the reality of the result. The author urges the making of a more extended series of comparisons by photography to give further evidence on this subject.

An interesting result of Mr. Schlesinger's study of the measures of the Præsepe stars is that the method of orienting the plate by the method of trails is not as accurate as that ba ed upon assuming the coordinates of several comparison stars on the plate, as determined by the meridian circle or the heliometer. It was Mr. Rutherfurd's rule to make two impressions of the regions photographed, stopping the clock for a few seconds between them, and also to give a third impression of the brightest stars by stopping the clock about three minutes and

making a brief exposure. In this way each plate contains its own data for orientation. The author thinks that the somewhat large discrepancies between this method and that by meridian circle observations is due to the jarring of the plate by stopping and starting the clock. Its value as an independent method, however, is recognized.

THE SOLAR ECLIPSE OF MAY 28, 1900.

THE committee appointed at the recent conference of astronomers and astrophysicists to consider the observations to be made at this eclipse has issued a circular letter asking for opinions as to the observations deemed advisable and what cooperation our American astronomers can render. The eclipse path extends from the Gulf coast to the Atlantic, but the duration of totality is short, only $1^m\ 13^s$ near New Orleans and $1^m\ 40^s$ near Norfolk, Va., according to the circular. The figures given by the circular of the English Nautical Almanac are a few seconds larger than these, $1^m\ 17^s.8$ west of New Orleans, and $1^m\ 45^s.6$ south of Cape Henry, Va. Some excellent points of observation may be found in Portugal and Spain, where the totality will range from $1^m\ 34^s$ to $1^m\ 19^s$. European astronomers are likely to locate at this end of the line. American observers should cover thoroughly the path through the United States, which includes many places readily accessible. The U. S. Weather Bureau has issued a second bulletin upon the probable weather to be expected. This is based upon special reports made in May, 1898, the former report including those of 1897. A third report for 1899 is promised. The conclusion thus far is that the most unfavorable weather is to be expected on the Gulf and Atlantic coasts, and that the most favorable locations are in the northern parts of Georgia and Alabama, upon the southern end of the Appalachian Mountains.

WINSLOW UPTON.

PROVIDENCE, R. I., March 15, 1899.

NOTES ON PHYSICS.

THE EFFECT OF COMMUTATION ON THE FIELD OF DYNAMOS AND MOTORS.

MESSRS. EVERETT AND PEAKE, in a paper on 'The Effect of Commutation on the Field of Dynamos and Motors' in the London *Electrician* of December 30, 1898, find, by means of an exploring coil and instantaneous contact maker, that the effect of commutation is to produce somewhat regularly recurring ripples in the curve connecting E. M. F. and position of the exploring coil, the maximum of the ripples occurring at intervals equal to the width of a coil, decreasing in magnitude as the distance from the commutated coil increases and nearly disappearing before the interpolar gap is passed. These ripples were found to be more marked with narrow than with wide brushes, which is explained by the damping effect of the adjacent short-circuited coils acting as secondaries to each other. The ripples are also more marked for heavy than for light currents and for motors than for dynamos.

TELEGRAPHY AND MAGNETIC INDUCTION.

S. EVERSHED, in an article on 'Telegraphy by Magnetic Induction' in the same journal, deduces a formula for the mechanical energy available in a distant secondary circuit in which no capacity is used, in terms of dimensions, resistance, frequency, etc., and from this calculates that in the case of two circuits using together 1,000 kgm. of wire, each 1,000 meters square and 10 kilometers apart, with a frequency of 100 and 100 watts in the primary, there would be available in the secondary .34 ergs. per second. Experiment shows that 2.9×10^{-6} amp. gives easily readable Morse signals in an ordinary telephone, this being double the audible current (this presumably for a frequency of 400). He then finds that in the above case, but with frequency equal to 400, there is 12×10^{-6} amp., and that hence the readable signals could be produced with 250 kgm. of copper. For satisfactory audible signals the frequency must be at least as high as 400, and here the undetermined effect of absorption of these waves by the material of the earth comes in. If this proves serious it may be necessary to use lower frequencies and other forms of receivers. A receiver is described consisting of a tuned rectangle of wire, vibrating in a strong field, or, better, two rectangles vibrating synchronously, but in opposite directions. Such instruments are being used at Lavernock and Flat Holm as

relays to close call-bell circuits. They are of iridio-platinum wire, 3 mils diameter and 2 by 4 cm. dimensions; they have a frequency of 16 per second, and with a clearance of 2 mils .001 erg. per second is required to bring them into contact. This can be used at a distance of 10 kilometers with $\frac{1}{3}$ ton of copper and would be little affected by the absorption; it has not, however, been adapted to the transmission of Morse signals. The power used by the telephone is more than 600 times the power used by the rectangle in this case. F. C. C.

THE BEQUESTS OF THE LATE PROFESSOR MARSH.

The will of the late Professor Marsh leaves his entire estate to Yale University, with the exception of $10,000 to the National Academy of Sciences. Its provisions are as follows: 1. The library which he had collected is to be placed in the Yale library, and all duplicates are to be given to the library of the Peabody Museum. 2. His home and the land surrounding it, nearly three acres on Prospect Hill, is given to the University to be used exclusively as a botanical garden 'and for no other purpose.' The garden is to be under the custody of a regularly appointed curator at a salary of $2,000. The house is either to be used as the residence of the curator or as a botanical laboratory, as his executors may see fit. In case the corporation does not wish to accept the house and grounds for this purpose Professor Marsh orders that they be sold and the proceeds added to the residuary estate. 3. His executors are ordered to sell all his pictures, paintings, furniture, bric-à-brac, silver and Oriental collections, the proceeds to be turned over to the University. 4. The gift is made to the University of a collection of 2,000 orchids and of all of his greenhouse plants. If not needed by the University these may be sold for the benefit of the estate. 5. The bequest is made of all of his scientific collections in paleontology, geology, zoology and archæology, to be kept in Peabody Museum. 6. He gives to the National Academy of Sciences of Washington $10,000 as a trust fund, 'the income to be used and expended for promoting original research in the natural sciences.' 7. The sum of $30,000 which, by the terms of the will of George Peabody, Professor Marsh was authorized to dispose of in his will, is left to the corporation of Yale 'to be expended by the trustees of Peabody Museum in preparing for publication and publishing the results of my explorations in the West.' 8. All the rest, residue and remainder of the property and estate real and personal, is given to Yale University to be used and expended by it for 'promoting original research in the natural sciences.'

The value of Professor Marsh's estate is said to be about $100,000, but may not prove to be as much. It will be remembered that somewhat more than a year ago Professor Marsh gave his extremely valuable collections in paleontology and other sciences to the University. It is estimated that these were secured at a cost of about $250,000. The Peabody Museum was given by Mr. George Peabody, Professor Marsh's uncle, through his influence. It should also be remembered that Professor Marsh never accepted any salary from Yale University.

SCIENTIFIC NOTES AND NEWS.

The first Hodgkins gold medal given by the Smithsonian Institution has been conferred on Professor James Dewar, F.R.S., for his work on the liquefaction of air.

Professor Helmert, of Berlin, has been elected a foreign correspondent of the Paris Academy of Sciences for the Section of Geography and Navigation. In the same section Père Colin, founder and director of the observatory at Tananarivo, Madagascar, was elected a corresponding member.

The Paris Academy of Medicine has awarded its Lecaze prize (10,000 fr.) to Dr. Widal for his serum method of diagnosing typhoid fever.

It is proposed, says the London *Times*, that a portrait of the late Dr. John Hopkinson should be placed in the Hopkinson Memorial Wing of the Engineering Laboratory at Cambridge University, the cost to be defrayed by subscription. A chimney piece which Mrs. Hopkinson has presented for use in one of the principal rooms contains a panel in which such a portrait could appropriately be placed. Mr. T. B. Kennington, who painted a portrait of Dr. Hopkinson some years ago, has suggested that instead of simply

copying that picture he could produce a better representation of Dr. Hopkinson as he was shortly before his death by painting an original portrait based on a recent excellent photograph and following the coloring of the previous portrait. Subscriptions are limited to two guineas, in the expectation that a considerable number of Dr. Hopkinson's friends not resident in the University, as well as residents, will wish to contribute. Among those who have already subscribed are the Vice-Chancellor, the Master of Peterhouse, the Master of Trinity, Sir Benjamin Baker, Sir J. Wolfe Barry, Sir Frederick Bramwell, Sir Douglas Fox, Sir James Kitson, Sir G. G. Stokes, Sir William White, Lord Kelvin, Lord Rayleigh and Lord Lister. Professor Ewing is treasurer of the fund, and he will receive subscriptions, or they may be paid to the Hopkinson portrait account at Barclay & Co., Cambridge.

THE statement sent from Washington to the press to the effect that Dr. Thomas J. See had been designated Chief of the Nautical Almanac is incorrect. Dr. See has been assigned to duty as Assistant in the Naval Observatory, but has nothing whatever to do with the Nautical Almanac office.

THE funeral services of the late Professor Marsh were held in Battell Chapel, Yale University, on March 22d. President Dwight conducted the ceremonies, and Professor George F. Fisher, of the Theological School, read the commemorative address. The pall-bearers were Charles D. Walcott and Arnold Hague, of Washington; Professor Asaph Hall, Cambridge; Professor H. A. Barker, University of Pennsylvania; and Professors William H. Brewer, Addison van Name, Edward S. Dana and Mr. George F. Eaton, of Yale.

DR. PHILIPP J. J. VALENTINI, a student in ancient Mexican and Central American history, and author of numerous publications, died March 16th, at St. Luke's Hospital, New York. Dr. Valentini's interpretation of the Mexican Calendar Stone placed him among the foremost American archæologists. He was born in Berlin in 1828, and received a careful training in philology from his father, an Italian teacher of languages and author of the first German-Italian dictionary. In 1854 Dr. Valentini went to Costa Rica, and there founded the seaport of Puerto Limon under government auspices. Learning of the obscurity of the Spanish colonization of Costa Rica, he returned to Germany to search for manuscript historical evidence. His first results in this line brought for him the recognition of Ph.D. from Jena. Later Dr. Valentini returned to Central America, where, continuing his investigations, he made many expeditions to Guatemala and other parts of Central America. In this work he received government encouragement, but political disturbances prevented his Spanish and German texts from being published by the government. Recognizing that to thoroughly understand Spanish conquests the pre-Columbian peoples must be studied, he began work upon the glyphs of the stone monuments and codices. Thirty years ago he came to New York to make use of the greater library facilities here, and since that time has been prominent among students of Americana. The American Antiquarian Society of Worcester has published many of his papers. His most recent publication is 'A Study of the Voyage of Pinzon,' printed in German in 1898. The major part of his notes and MSS. remain unpublished.

HARLAN I. SMITH.

DR. OLIVER MARCY, professor of natural history in Northwestern University, and dean, died at Evanston, Ill., on March 19th. He was a Fellow of the Royal Geographical Society, a member of the American Ornithologists' Union, and of other scientific societies.

PROFESSOR GUSTAV WIEDEMANN, professor of physics and chemistry in the University of Leipzig, well known for his contributions to electricity and magnetism, has died.

MAJOR J. EVANS, professor of pathology in the Calcutta Medical College, died on March 13th from the plague. He is believed to have contracted the disease while engaged upon the *post-mortem* examination of a plague patient.

AMERICAN men of science should see that the decimal system of weights and measures is maintained in Cuba, Porto Rico and the Philippines. It is the first principle of colonial gov-

ernment to respect the customs of the native peoples, and we certainly should not fail to do this in a case where their customs are better than our own.

An appropriation of $170,000 has been passed by the Massachusetts House for the extermination of the Gypsy moth.

The German Reichstag has made a grant of 60,000 Marks for Professor Robert Koch's approaching expedition to the tropics to investigate the nature and origin of malaria.

It is said that Mr. Andrew Carnegie is prepared to give the Pittsburg Carnegie Library $1,000,000 endowment and $500,000 additional for improvements when the city authorities have appropriated $3,500,000 for Shenly Park.

By the death of Mrs. A. H. Colson a bequest of $25,000 for the library of Stafford, Conn., becomes available.

The Ohio State University announces for the summer of 1899 the maintenance of a lake laboratory at Sandusky, the purpose of which is to provide laboratory facilities to any who may wish to engage in the study of the numerous forms of life there accessible. No courses of instruction are designed and no laboratory fees are charged, the special purpose being to provide opportunities for investigation. Still, the opportunities for mutual improvement among a circle of earnest workers, by comparison of methods, discussion of results and exchange of ideas, are too evident to need mention. The variety of life accessible is unsurpassed, as the lake, river, extensive bays and marshes afford a basis for life conditions of great richness. The laboratory is provided with tables, aquaria, boat and other essentials, and necessary seines, dredges, nets, etc., will be available when needed. Rooms and board may be had convenient to the laboratory at very moderate prices, and as, aside from the attractive locations along shore, the beauties of Kelley's, and Put-in Bay Islands are readily accessible by boat the opportunities are most favorable to combine a few weeks of earnest study with the recreations of a summer outing. Each investigator will be expected to provide his own microscope, microtome and such special appliances as he may need in his particular investigation, unless otherwise arranged, but will be supplied with the usual reagents, glassware, etc., and will be given entire freedom in the matter and method of his investigation, except for such necessary arrangements concerning use of boat, assignment of table aquaria, etc., as may be necessary to secure equal advantages to all. The laboratory will be open from June 15th to August 15th, or, possibly, till September 1st, if desired by a number of workers. Advanced students, instructors or any persons qualified to use the facilities offered are cordially invited to avail themselves of the opportunity here provided. Further particulars may be had by addressing Professor Herbert Osborn, Department Zoology and Entomology, Ohio State University, Columbus.

UNIVERSITY AND EDUCATIONAL NEWS.

We recently announced that Mr. Robert S. Brookings had offered to give $100,000 to Washington University, St. Louis, on condition that $400,000 be subscribed by others. This sum has now been given and the $500,000 has been added to the endowment fund of the undergraduate department. This is in addition to the $450,000 given for buildings within the past six weeks as described recently in this Journal.

The Woman's College, of Baltimore, will receive between $25,000 and $50,000 as the residuary legatee of the late George R. Berry, of that city.

The Teachers' College, Columbia University, will erect, at a cost of $350,000, a bulding for its model school, the Horace Mann School. This will give, in its present buildings, more ample accommodations for the regular courses.

Six new scholarships of $100 each have been established in the Sheffield Scientific School of Yale University. They will be awarded to members of the graduating class who stand highest in scholarship.

Mr. W. J. Blankinship has been appointed professor of botany in the Agricultural College of Montana.

Mr. R. C. Maclaurin, Fellow of St. John's College, Cambridge, has been called to the chair of mathematics in Victoria College, New Zealand.